and judging by the past non-activity of the government in educational matters it might take twenty years of agitation before congress could be induced to make the necessary appropriation. The government has a Department of Agriculture which is making experiments for the farmer, to enable him to grow larger and better crops, a Bureau of Forestry which is trying to conserve our forests, a Bureau of Mines which is experimenting on improving the methods of mining and on the prevention of accidents. It has also a Bureau of Education, which publishes statistics of schools and colleges and some interesting papers on educational subjects, but which has never investigated academic efficiency or carried on an educational experiment. All educational reforms in this country have been originated by individual philanthropists or by individual universities. They do not come about by normal process of evolution in the educational world or by governmental action, with perhaps the single exception, the Morrill Land Grant Act of 1862, just fifty years ago. We therefore must look for a millionaire philanthropist to begin the great educational experiment which will lead to improving the methods of training our future citizens.

Our modern educational literature, addresses of college presidents, school superintendents, proceedings of societies, etc., all show the prevailing consensus of opinion that there is something seriously wrong with our whole educational system, and that instead of getting better it is constantly tending to grow worse. There exists also a great amount of ultra-conservatism and of mental inertia relating to the subject. It is high time that something practical be done in the way of reform.

WILLIAM KENT

THE PROBLEM OF ORGANIZATION

II

THE PROGRAM

I have heard the title "philosophical biologist" applied to biologists who talk about such matters as this problem of organization. The honor is totally unmerited. The problem is in strictest sense a biological problem. No doubt philosophy is interested in its solution. Philosophy is and ever has been a field for speculation about unsolved biological problems. When biology and other natural sciences shall have solved all their problems, a considerable burden will have been lifted from the shoulders of philosophy. This helpful relation should, however, be a mutual one. Science will never solve its problems—at most, it will never do more than think it has solved them—unless it constantly realizes its own limitations and unless it frequently assures itself of the security of its foundations. Now, perhaps more than at any other time, the natural scientist stands in need of help which may well come from the philosopher. Is it not timely to raise the question as to the validity of the assumptions upon which science rests and the integrity of the methods by which we attempt to progress? Science is a tool by means of which the human mind seeks truth. This tool was not fashioned by some omniscient being and bestowed upon man for his use. He made it himself. Is it possible that the tool is now antiquated in its structure or so distorted and worn with long use that it no longer cuts true?

This problem of organization, in the sense in which I have stated it, is not only a biological problem. It is in a broad sense a physical problem. The materials of biological science consist of those substances which we call living, and the energies whose existence is revealed to us by the motions of the bodies composed of those sub-

stances. In the formation of a crystal we conceive of certain energies working in certain ways. Every formative event in an organism is a phenomenon of matter in motion. The investigation of form and organization reduces ultimately to an investigation of the energies involved in the motions and configurations of certain substances—biophysics. We would know the nature and mode of operation of these energies. Are they resultants or complexes of forms of energy with which we feel ourselves somewhat more familiar as we view them in the non-living? Or shall we find that living substance serves as the vehicle for energies peculiar to itself? In the latter case we shall simply have lengthened the known list of truly physical agents, that is, agents which are involved in the motions of molecules capable of analysis into known chemical elements. If any peculiar energetic properties of living substance should be demonstrated, whether such energies should be regarded as physical or non-physical is a question, not of fact, but merely of terminology.

But before we can preface our inquiry with "what" and "how," we must first ask, where? Our problem of organization is to a large extent the problem of determining the situation of the energies involved in the formation and harmonious operation of organic systems. One important step has already been gained. It is not so long since we looked hopefully to the environment in which the animal lives as the seat of some, if not all, of the energies of organization. Now we know that the germ possesses something more than merely the fundamental capacities for metabolism and growth. It is not a bit of indifferent plastic substance which is molded into shape by an elaborate complex of environmental forces. The energies which underlie organization are seated in the living substance itself. We now press our question one step further. Where, in relation to each system of the organism, are the energies which produce the organization of that system? Does each organic unit contain within itself an energy-complex sufficient for the part played by that unit in the system to which it belongs and in all higher systems, or shall we find more comprehensive energy-complexes transcending and dominating the intrinsic energies of all the units of a system?

It is in the developing organism that this problem of organization most insistently demands our attention. There we see the complex arising from what appears to be simple, system growing out of system, one organization after another derived from something which gave within itself no evidence of the existence of such organizations. The adult organism presents more nearly a static condition. When we understand how organic systems arise in ontogeny, we shall doubtless be in a fair way to know, if we do not then already know, how organization is maintained in the adult. Not only is the problem essentially a problem of the developing organism, but development offers to the investigator the most promising field of attack. He is by no means restricted to embryonic development. Regenerative development involves essentially the same processes as embryonic development. Precisely the same problems exist in both and for obvious practical reasons there are great advantages in favor of experimentally controlled regeneration as a means of discovering the location of the energies which produce organization.

Units of organization representing at least the more conspicuous grades of units which we see in the adult appear early in the ontogeny of metazoa. At first we see cells only, but very soon they become disposed in sheets or layers which, so far as

visible structure is concerned, are the embryonic equivalent of tissues in the adult. These germ layers almost immediately undergo local modifications wherein we see the embryonic equivalent of organs. And before development progresses very far, structural peculiarities appear which correspond to specific characteristics of the whole individual. As the observer attempts to follow these events of ontogeny he soon finds himself confused and lost in so great a complication of developmental operations that he can no longer surely distinguish processes which are functions of the organization of cells as cells, and processes which are functions of the organization of embryonic tissues, and others which may be functions of units of organization of yet higher grade.

In our approach toward the problem of organization, a step of the utmost importance will have been gained when we have so far analyzed developmental operations that each component process may be positively identified as the function of a structural unit corresponding to an organization of a certain grade. We must at the outset clearly distinguish between processes which depend upon the operation of protoplasmic mechanism of one grade or another, and those events or conditions which are entirely independent of active physiological factors, as, for example, when the orientation of an egg cell in space and the distribution of some substance in the egg are directly due to gravity acting upon a heavy yolk. We must then determine, for each truly physiological developmental event, its value or position in the scale of organizations. We shall then have come to recognize in a certain developmental event, for example, a process which requires the operation of no organization higher than that which is fundamentally inherent in all cells. Any cells whatever, being in that particular physiological state—that is, as regards general metabolic conditions and the like—and placed in that particular physical environment, would exactly reproduce the developmental event which is before us. (I distinguish between the physical environment which includes all those conditions, such as temperature, pressure, chemical constitution of the medium, which are either independent of the structure of protoplasm, or only indirectly or remotely determined by it; and the physiological environment, essentially physical in nature, which includes the action of immediately present specific protoplasmic mechanisms.) Thus, it is conceivable that the earlier cleavage events, in at least some animals, are of this elementary character, inasmuch as they may show no definite or necessary relations to the organizations which appear later. In many cases the cleavage plan may be profoundly modified without important effect upon the subsequent development. In another instance we may distinguish a process for which the mechanism common to all cells is not adequate. It is, we will suppose, a process requiring, superimposed upon the essential cell mechanism, something else which results in the association together of numerous similar cells to constitute a layer or tissue of specific structural and physiological character; for example, the ectoderm. Beyond that in this case we need not go, for it becomes clear to us that any group of cells whatever, belonging to a tissue of this type and placed in a physical situation like that which exists in our supposed case, would exhibit that particular formative behavior which we have there observed. It is the essential point in this case that the process is one which has no necessary relation to the specific features of an organ or any higher complex of the individual. It may, indeed, be a process which partici-

pates in an important way in the development of an organ, but it contributes nothing of specific character to that organ inasmuch as tissue of the same type would play precisely the same rôle in the development of any other organ. It is therefore essentially a tissue process, being one which in no way bears the impress of any higher organization of the individual. The inherent propensity of an epithelium for investing a surface illustrates the tissue process.

In yet another instance we see a group of tissue elements undergoing changes which result in the establishment of some specific feature of an organ, such as the alveolus of a gland, or a Bowman's capsule of the kidney. Not every group of elements belonging to the type of tissue concerned would, even if placed in the physical situation occupied by the group under consideration, give rise to that same structure. It is clear, however, that a certain structure may upon occasion be formed by a group of elements other than that which would normally give rise to it. The tissue elements which normally do form a certain structure of high order, and those which in emergency can do so, must either contain within themselves or encounter in their environment an energy-complex which determines their activity. Something, therefore, must be added to or impressed upon the organization of an epithelial tissue or else something corresponding to the organization of the higher system must dominate the tissue organization. In this case, then, we have an example of a developmental event which owes its occurrence to energetic factors belonging to that grade of organization corresponding to those larger structural complexes which, in the ordinary anatomical sense, we call organs.

Finally we observe that organs develop in such a way that certain larger structural complexes are established. The several organs come to have, in a great variety of ways, very definite relations one to another. Especially conspicuous are the spatial relations which result in a certain body plan and general form. These larger relations and peculiarities characterize an organic unit higher in grade than the organ, namely, the organism as a whole or the individual or, as Haeckel names it, the person. We meet here precisely the same problem which we have met at every other level of organization. It is conceivable that absolutely indifferent cells exist—cells possessing no organization beyond that represented in the structural substratum common to all cells. When a cell becomes a tissue cell the fundamental cell organization must have been modified or something must have been added to it or something must dominate it. Further, a tissue as such, while possessing certain definite habits of growth, is indeterminate in form. In an epithelium one dimension, thickness, is approximately determined. In muscle tissue no dimension is determined. When a tissue becomes shaped into an organ or some part of an organ, the fundamental tissue organization must have been modified or something must have been added to it or something must dominate it. Still further there is no universal necessity governing the larger relations which exist amongst organs. We need only compare individuals of different species to see that similar and corresponding organs may be related to one another in a variety of ways so that individuals very unlike in body plan and general form result. Somewhere in ontogeny must exist energetic factors responsible for these larger features which characterize the individual as a whole. These factors may consist in modifications of organizations of lower orders or in something added to them, or they may consist in some energy-complex which transcends

and dominates inferior organizations. Beyond denial *there is a specific something,* if it be nothing more than accidental chemical peculiarities of cells or smaller units, which corresponds to the organization of the individual as a whole. When, therefore, we see two organs arising in an embryonic cell layer which is otherwise lacking in visible differentiation, the distance between these two organs bearing to other dimensions in the embryo a ratio which is fairly constant for embryos of that species, we have before us an instance of the operation of the organization as a whole.

Many developmental events we may even now attribute, with a fair degree of confidence, to organizations of certain grade. Perhaps this is to a greater extent true of the later and more complex developmental operations than of the earlier and simpler. When we see a limited region of a tissue whose physical (in distinction to physiological) environment can not be far from homogeneous give rise to a structure of considerable complexity, it is highly probable that the action of an organization higher than that of the tissue is involved. But who can say whether the typical process of gastrulation is a function of cells or of cell layers? Do the factors concerned in gastrulation consist of a certain physical environment plus cell organization, or does this process depend essentially upon that higher organization in virtue of which the embryonic cells are associated together in a blastoderm, or does it involve specific factors higher in grade than those which determine organization as a mere cell layer? Or, indeed, does it involve no protoplasmic mechanism of any grade, being entirely dependent upon the physical environment and the gross physical properties of the blastula wall? While I am strongly of the opinion that gastrulation depends upon physiological factors of an order higher than cell organization, I can not offer absolute proof of it.

When we have identified the grade of the organization responsible for a particular developmental event, our next task—doubtless a much more difficult one—will be to discover the location of the dynamic factors which determine that event. Are they numerous, mutually independent, collectively uncontrolled, seated in the several elements of the responsible system, the event in question being merely the resultant effect of their separate operation? Or does some larger dynamic agent dominate the behavior of all the subordinate members of the system? When we have accomplished all this we may well feel encouraged to press on to the discovery of the mode of operation and the nature of these organic energies.

THE REALITY OF ORGANIZATION

Now the question arises whether this conception of organizations of various grades consists in anything more than an artificial and arbitrary classification of the complex phenomena of ontogeny and of the complexities of adult structure. Is it not of the same nature and value as our classification of animals? We have devised a scheme whereby we regard animals as segregated into a series of groups—species, genera and so on—subordinated one to another. We arbitrarily separate these groups by sharp lines. While the scheme expresses, to some extent, our ideas concerning the past history of animals, the groups themselves have no real existence "in nature," as we say. There these sharp lines do not exist. The species or other group has no definite limits in space, no form, no integrity. It has no organization as a whole. It is true that some close analogies may be drawn between phylogenetic

history and ontogenetic history. We conceive of phylogeny as working from the simple to the complex. An original ancestor gives rise to series of animals which inherit peculiarities of the common ancestor and acquire various additional peculiarities. It is a process of differentiation. The oosperm is the original ancestor of all the cells of the individual. Ontogeny works from the simple to the complex. As it progresses cells "inherit" certain peculiarities from the common ancestor, the oosperm, and "acquire" other peculiarities which, so far as visible structural features are concerned, are new for that individual. Thus arises differentiation into the numerous types of tissue cells. (It is a curious inconsistency of the scientific mind that in ontogeny, where we can directly observe the history of the whole "race" of cells, having before us both the beginning and the end of their evolution, we are strongly inclined to believe that the "new" characters which appear as differentiation progresses were somehow potentially present in the common ancestor, the oosperm. Turning from this evolution of a cell kingdom to that larger evolution of an animal kingdom whose beginning and end we can not compass, of whose history only a brief and far from lucid chapter lies within our observation, we are equally strongly inclined to look for the causes of new characters anywhere under heaven rather than to attempt to think of them as having been somehow latent in a remote ancestor!)

In spite of striking analogies, phylogeny and ontogeny are quite clearly different in their mode of operation. The noteworthy feature of ontogeny is the concerted and coordinated behavior of many elements, either of the same kind or of different kinds. This harmonious action of elements gives rise to configurations which are definite and limited. Within phylogenetic groups such coordinated behavior of numerous individuals does not, in general, exist. We see something similar to it in the social organizations of some animals, but outside of the human species it is exceptional. Within the human species social organization is all-important. There are conspicuous analogies between the coordinated behavior of human individuals and the concerted action of the structural elements of an individual. We may well raise the question whether an unprejudiced and open-minded study of these analogies may not serve to guide us toward the truth in our attempt to interpret and "explain" the organization which we see within the individual. For the single cell and the whole multicellular animal are both living beings of one kind or another. This brings us to the edge of a vast subject whose full discussion at this point would be both premature and aside from our main thesis.

In general, then, phylogenetic groups lack organization. They possess no form unless it be geographical distribution, and this, even were our knowledge of it complete, must be so indefinite that it can be described only by means of arbitrarily drawn lines. In geographical distribution there is nothing closely comparable to the problem of form within the individual. Distribution has its problems, but the factors in it are relatively well known and intelligible. In general they consist, upon the one hand, of the various conditions contained within the physical environment and, upon the other hand, of the peculiarities in the organization of the individuals of the group. But these are the peculiarities of the organization of the individual *as an individual*. So far as form is concerned, and aside from the relatively rare phenomena of social organization, there is

no evidence that a species or other group contains any organization higher than that of its members as individuals. *This lack of form in the phylogenetic group is most significant in the present connection, for it affords us an example of what results, in the way of form, from the action of physical environment on a group of living units possessing no organization higher than that of each individual as such.* In contrast to this we see everywhere in ontogeny precisely coordinated action of numerous elements resulting in forms which are not only definite, but elaborate. The physical environment in ontogeny may be considerably altered, yet these forms insist upon developing. Is it not futile, at this stage of our knowledge, to attempt to think of tissues originating in ontogeny by the action of a physical environment upon indifferent cells, or to think of organs arising similarly from indifferent tissues? While it is becoming that science, as well as scientists, should be modest in its claims, nevertheless to underestimate our knowledge merely retards progress. We now possess a large body of well-authenticated data upon ontogeny. I can not see in these data the least evidence that an environment which is, in the ordinary sense, purely physical—that is, devoid of specific physiological factors—has any power whatever to organize living substance. Upon the other hand there is every evidence that organization arises within the living substance and that the living organizes the non-living. To admit that originally the living arises spontaneously from the non-living by any such process as fortuitous concourse of atoms is explicitly to deny that the non-living has organizing power, for then organization begins by accident and higher organizations could arise only by continuance of accidents within the living substance itself, environment merely acting selectively. Even if chance is the creative element in phylogeny, it is not so in ontogeny. The development of the individual does not progress by trial and error.

We must admit, I believe, that in ontogeny cells are somehow directly and actively organized into tissues, and tissues and cells are still further organized into organs. The physical environment of a group of embryonic cells is no more capable of organizing those cells into a higher complex of elaborate form, than is that larger environment in which the whole animal lives capable of directly determining in ontogeny the form of the animal as a whole. I see no escape from the conclusion that specific organic or physiological factors—dynamic factors seated in protoplasmic structure—are involved in this organizing of lower structural elements into higher.

Furthermore, our analysis of the adult organism into organs, tissues and cells of various kinds is not, to any important extent, arbitrary. Here sharply drawn lines do exist. In the adult animal we do not find cells which constitute a continuous graded series between two distinctly different types of cells. A cell is either one thing or another. Neither do the several types of tissues in any individual merge indistinguishably one into another, as do species. In ontogeny a cell of one type may become transformed into a cell of another type, passing gradually through all the intermediate conditions. But the change is completed so that ultimately the cell is distinctly of one type and not of the other. If in the adult animal there are "indifferent cells," they are not indifferent in the sense of being indefinitely intermediate in character between cells of different types. Their very indifference con-

stitutes them into a class sharply separated from differentiated tissue cells. Or they may be potential tissue cells which have not yet undergone their definitive transformation. When therefore we say that an animal is composed of organs, the organs of tissues, and the tissues of cells, we are not merely proposing a classification for the sake of injecting some order into complex structural data. Clearly, this scheme of organic structure represents substantial existence.

Our conviction of its reality is corroborated by the facts of development. It is true that ontogeny, like phylogeny, is a process within which at every point there is gradual transition from one form to another. Here again, then, are we not arbitrary in attempting to distinguish organizations of distinctly different grades? No, for there is this profound difference between phylogeny and ontogeny. In phylogeny the intermediate forms to a large extent persist as such, and each intermediate individual has precisely the same organic value as any individual of either of the species between which it is intermediate. In ontogeny the transitional stage is of relatively brief duration. While in this stage the element has the organic value of that unit of higher order which it is destined to become, and not that of any unit of lower order. It is intermediate therefore only in external aspect. It is potentially an element of a distinct type and it is assuming the structural characteristics of that type as rapidly as the organic energies concerned can elaborate them. Ontogeny, then, while it is in a sense a process in which there is gradual change from one thing to another, is nevertheless a process whose essential feature is the establishment of sharply marked differences. This comparison between phylogeny and ontogeny is, of course, open to the objection that we describe the developmental process with reference to its end, which we are able to observe, while the end of the phylogenetic process does not yet appear. Finally, the sequence in which structural systems make their appearance in ontogeny corresponds to the relations which they exhibit in the adult. In general we actually see, in the embryo, cells building up tissues, tissues building up subsidiary organs, and these uniting to form successively higher organic complexes. Were the sequence otherwise, we might well doubt if our conception of organizations of various grades, one subordinated to another, had any real value.

When, therefore, we attempt to liken a tissue to a species, the comparison soon becomes forced. It is quite clear that the tissue is a real thing, a definite configuration of matter, exhibiting certain physical and physiological properties which can only be regarded as the expression of a precisely corresponding dynamic complex. The species, no less real, is a human concept. In view, then, of the known facts of adult structure and of ontogeny, and by comparison of these facts with what we know of phylogeny, we can hardly escape the conclusion that our conception of the individual as representing, in its entirety, the highest of a descending series of organizations is, so far as it goes, a statement of biological truth.

CONSEQUENCES

Granting that this conception of the constitution of the individual organism represents substantial reality, the problems therein presented to us are not rivaled in importance by any with which biology has to deal. The problems of heredity and evolution are intimately, inseparably, related to this one of organization, for they, too, represent one aspect or another of the

fundamental problem of organic form. When we understand the dynamics of form in the individual organism, we shall be well on our way toward understanding how a certain form is repeated in a series of genetically related individuals, and how in phylogenetic history form may undergo change. Of supreme importance to us is a knowledge of the nature of our own organization. It is perfectly clear to us that we ourselves are animals and that the attributes and powers which we possess are shared in greater or less measure by other living beings. So far as form and organization are concerned, we recognize other animals so nearly like ourselves that we include ourselves with them in the same sub-order of our scheme of classification. Whatever shall be found to be true regarding the nature of the organization of other organisms must inevitably be true of our own organization. The full realization of this truth must have for us a significance which it is now quite impossible to estimate. The intellectual value of so great an addition to our knowledge affords in itself sufficient motive and justification for the pursuit of that knowledge. Beyond this intellectual value lie utilitarian possibilities whose value exceeds conjecture.

If we shall succeed in proving to our complete satisfaction that organization is the resultant effect of the action of autonomous elements—that it is merely an appearance presented to us by the results of the curious accidents of molecules—our attitude toward ourselves and toward the universe in general must, so far as we realize the full import of that view, be profoundly affected thereby. If any one objects that this view, if true, is an undesirable truth and that we might better not know it, we can only reply with the faith that the truth can not hurt us, and in any case science is bent upon having the truth at all costs. Indeed, if this conception is carried to its logical conclusions, they who would prefer not to come into the knowledge of such truth can hardly help themselves, for whether they know it or not lies hidden amongst the secrets of molecular accidents yet to happen. In the mechanically deterministic universe to which this view of organization naturally, almost inevitably leads us—one in which our conscious life becomes a meaningless, even if interesting, replica of an inexorable physical concatenation—we may at least enjoy our freedom from responsibility for our own fate and the destiny of our race. Indeed, it may be permitted to us to hope that we are destined so to react within and upon the physical order that its psychic reflection shall come to contain less of pain and more of pleasure.

That other conception of organization which attributes the harmonious action of a system to forces which dominate the behavior of the members of the system appears, at the outset, more inviting to us and richer in possibilities for us. If we shall succeed in demonstrating to ourselves the existence of such dominating organic energies, we at once meet further questions of far-reaching importance. There would, however, still be enough left in the unknown respecting organisms to provide material for speculative inquiry which might tend, as we have already intimated, in the direction of any one of a variety of philosophical attitudes. In fact, in the present state of our knowledge this theory of dominating energies may be made, if one so pleases, as rigidly and narrowly mechanical and as severely deterministic as any other. Upon the other hand, it freely opens the way to the more flexible and more generous universe demanded by him

whom I once heard William James designate as the "soft-minded man," in distinction to the "hard-minded" person of materialistic tendencies. The biologist, or biophysicist, however, and in certain important aspects of the problem the psychologist too, will press forward their investigations of form-dominating energies with, we will hope, supreme disregard for philosophical consequences.

With each ascending step in the series of organizations, the possible existence of a dominant factor becomes of greater significance. When we reach that highest level with which the biologist ordinarily has to deal, the organism as a whole, or the individual, we have to contemplate the existence of a dynamic agent which bears, to the form of the whole organism, somewhat the same relation that higher nervous centers bear to the coordinated muscular activities of the body as a whole. How far in the descending series of organizations is any such dynamic factor of the whole directly operative? Does it exert any direct influence upon lower units such as cells? What can be the nature of such energies? What is their relation to the energies with whose manifestations in the so-called inorganic realm we are inclined to feel ourselves somewhat more familiar? Do they endanger the integrity of that foundation rock of science, the principle of the conservation of energy? Finally, what is their relation to the conscious voluntary life of the individual?

When we trace the process of evolution in inverse order, everything organic appears to converge into a primitive and simple bit of living substance. Can we escape the conclusion that the elements of every power and attribute possessed by the highest and most complex organism are inherent in the simplest protoplasm? To this question no dogmatic answer, but at best merely a statement of opinion, can be given. In simple unicellular organisms and also in individual cells of multicellular organisms, the various operations involved in metabolism, in reproduction and in movement, are all carried on in one common protoplasmic body in which we can discover no separate mechanisms or organs corresponding to the several functions. (The temporary organs of mitosis appear to take their origin, upon occasion, from this common protoplasmic body.) Shall we not be obliged to credit the unicellular organism, at least—and if that, why not a leucocyte or a tissue cell too?—with the possession of some elemental germs of consciousness and will? Or is it more reasonable to assume that these attributes of the living have been created *de novo* and injected into organisms at a more or less advanced stage of evolution? If we admit the existence of some degree of consciousness and volitional action in a protoplasmic body in which there is not only no nervous structural mechanism, but in which all of the vital operations are carried on as functions of the whole and not as functions of localized separate mechanisms, we encounter the possibility that primitively all of the vital activities are equally linked with consciousness and will. If, now, there exists in this common protoplasmic mass a dynamic agent determining form, how shall we exclude it from this same relation with consciousness and will? Or, to suggest what is, to the general biological mind, the remotest of psychophysical possibilities, is this dynamic agent which organizes living substance identical with conscious will? To weave further this filmy tissue of possibilities, assume that primitively the determination of form, together with all other vital or protoplasmic operations, was somehow linked with primitive volition. How, then, in the course of evolution has the control of form, together

with various other physiological operations, come to be so far removed, as in our experience they seem to be, from the voluntary life of the organism as a whole? Is it conceivable that in the full light of knowledge of the nature of organization we might acquire some degree of conscious and voluntary control, either direct or indirect, over these organizing and form-dominating energies? Herein, surely, would lie a most potent factor in the further evolution and destiny of our own race.

The contemplation of the imaginable consequences of this idea of dominant organizing energies overwhelms us beneath an avalanche of questions, of whose asking the only justification lies in the fact that they are properly biological questions for which biology at present has no answer. Certain of these questions may seem to carry us beyond the world of possibilities and into the misty realm of dreams. Yet, does not what we dream become possible even in the dreaming?

Herbert W. Rand
Harvard University

THE BEQUESTS OF THE LATE MORRIS LOEB

By the will of the late Morris Loeb, formerly professor of chemistry at New York University, large bequests are made to educational, scientific and charitable institutions. Subject to the life interest of Mrs. Loeb, $500,000 is bequeathed to Harvard University for the advancement of physics and chemistry. Twenty-five thousand dollars are bequeathed to the American Chemical Society for the establishment of a type museum of chemicals, to be established in the Chemists' Club of New York City, the U. S. National Museum or the American Museum of Natural History, and $2,500 is bequeathed to the National Academy of Sciences. His stock in the company owning the Chemists' Club is bequeathed to the company. Fifty thousand dollars are bequeathed to the Hebrew Technical Institute and $250,000 to the Solomon Betty Memorial Home for Convalescence. The residuary estate, subject to Mrs. Loeb's life interest, is to be equally divided among the Smithsonian Institution at Washington and the following New York institutions: The American Museum of Natural History, the Metropolitan Museum of Art, Cooper Union, the Hebrew Technical Institute, the New York Foundation, the Jewish Protectory and Aid Society, the Hebrew Charities Building and the Educational Alliance. The Smithsonian Institution receives its bequest to further the exact sciences. The American Museum of Natural History is to get a collection for the illustration of the industrial use of natural products in ancient and modern times. The Metropolitan Museum of Art is to purchase and exhibit objects illustrating the development of artistic handicraft in Europe and America. Cooper Union is to endow a professorship. The Hebrew Technical Institute is to establish technical courses for mechanics. The Jewish Protectory and Aid Society bequest is for the relief of employees. The Hebrew Charities Building is to use the money to establish a library and to reduce the rent for the charitable societies occupying the building. The Educational Alliance is to devote the gift to work among women and children.

SCIENTIFIC NOTES AND NEWS

Dr. Carl L. Alsberg, chemical biologist of the Bureau of Plant Industry, has been appointed chief of the Bureau of Chemistry in succession to Dr. Harvey W. Wiley.

Mr. W. H. Fox, of Philadelphia, a student of art, has been appointed curator in chief of the Brooklyn Museum to fill the vacancy caused by the resignation of Dr. Frederic A. Lucas, to accept the directorship of the American Museum of Natural History.

The anniversary meeting and dinner of the Royal Society was held on November 30. Sir Archibald Geikie made the annual address. At the dinner toasts were proposed by Sir Rickman Goldee, president of the Royal College of Surgeons, by Prince Lichnowsky, the German ambassador, and by Professor Elie